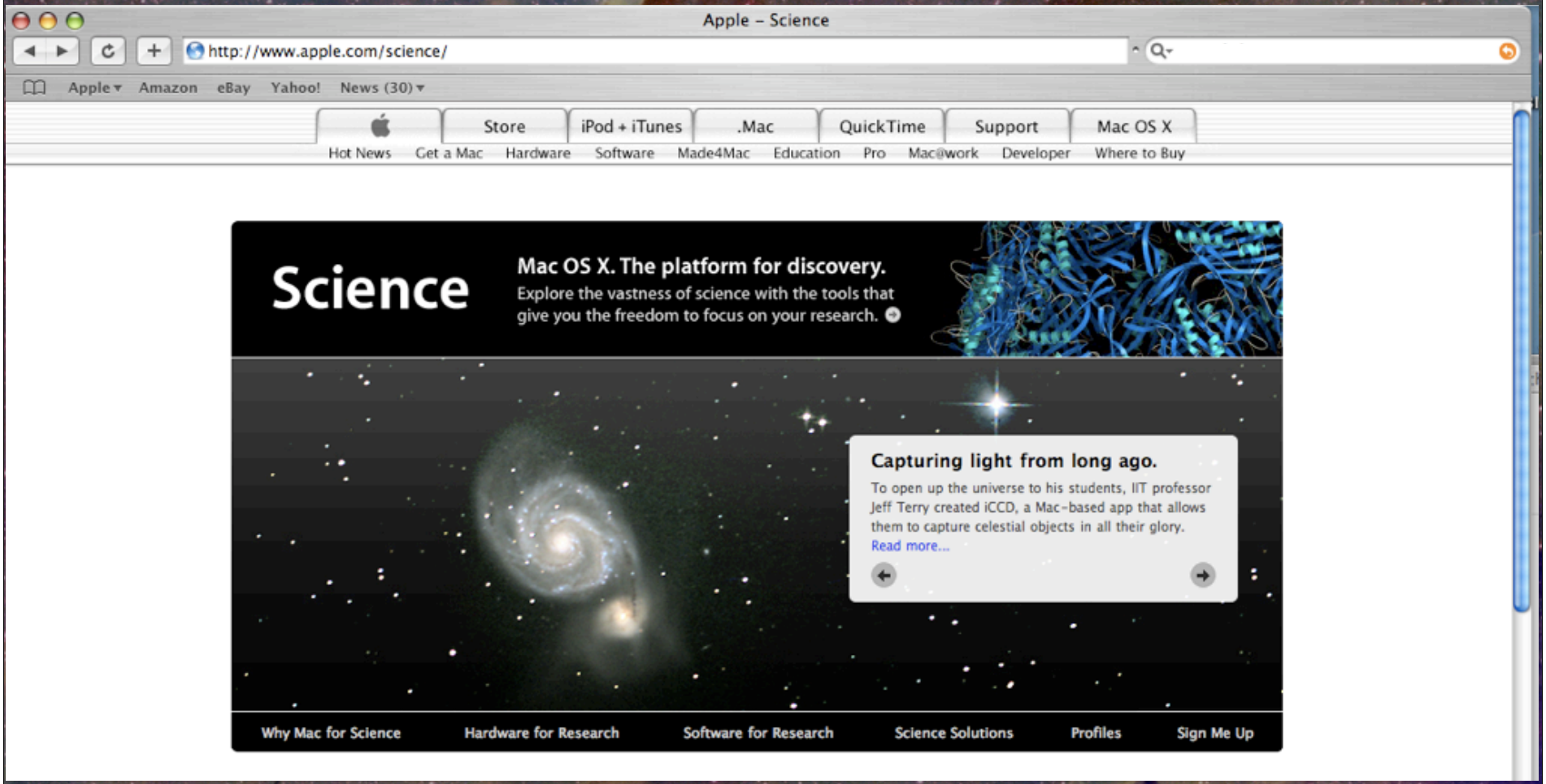
iCCD For Image Processing And Image Collection

Jeff Terry

Midwest Astroimaging Conference

July 14, 2007

Why Am I Here?


Apple – Science
http://www.apple.com/science/
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iPod + iTunes
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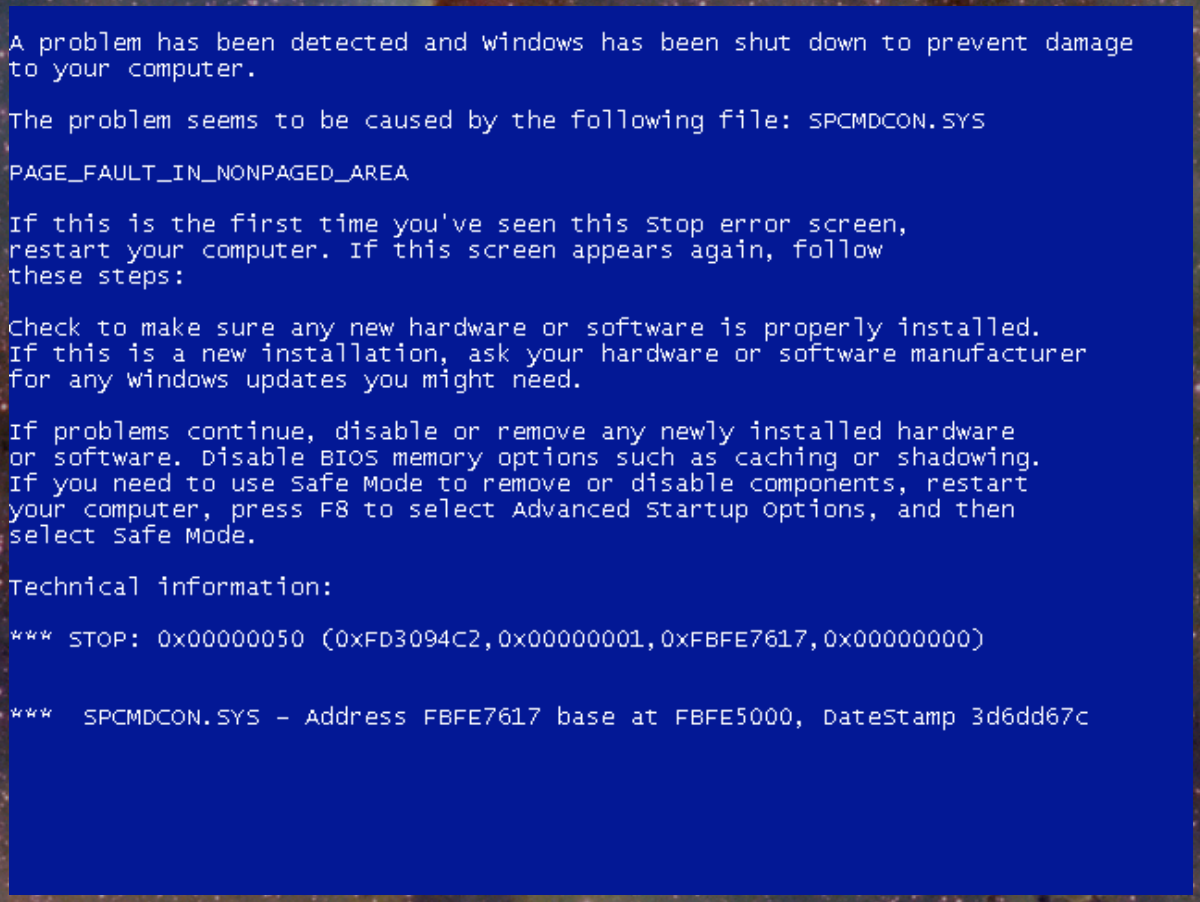
Science
Mac OS X. The platform for discovery.
Explore the vastness of science with the tools that give you the freedom to focus on your research.
Capturing light from long ago.
To open up the universe to his students, IIT professor Jeff Terry created iCCD, a Mac-based app that allows them to capture celestial objects in all their glory.
Read more...
Why Mac for Science
Hardware for Research
Software for Research
Science Solutions
Profiles
Sign Me Up

Why Macs?

Apache Point 3.5 m

- 3.5 m Run With All Macs. Sloan Moving That Way

Engineers Dig The BSOD

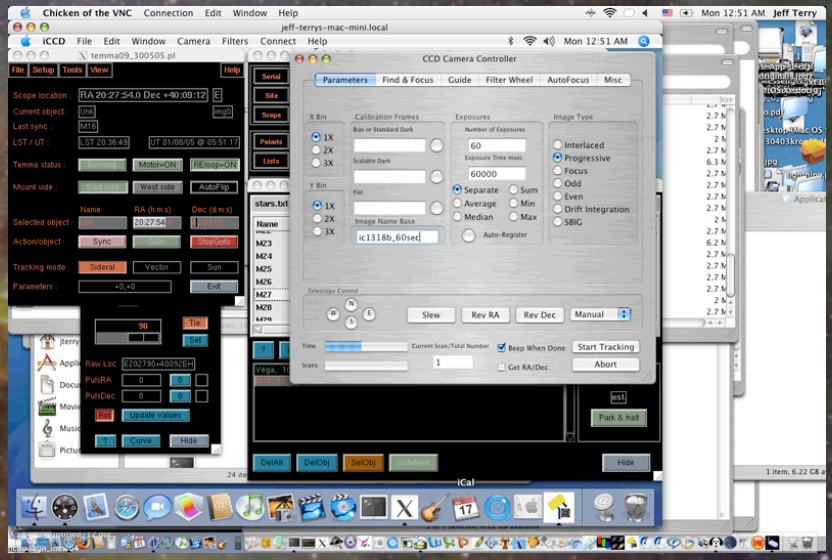


- Not Scientists

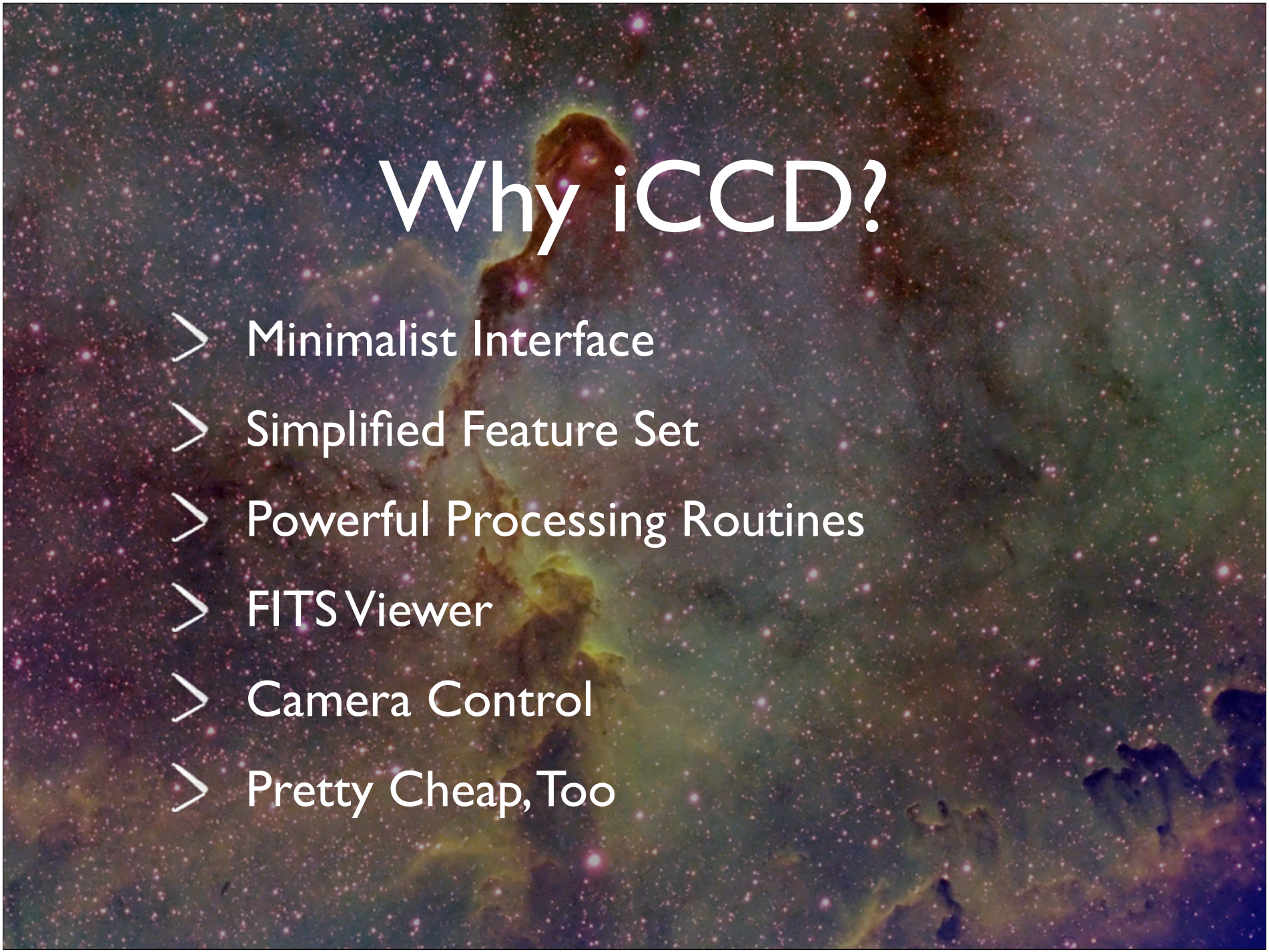
Telescope

- IPRO Course

Telescopes



- Mac mini fits perfectly on the tripod tray

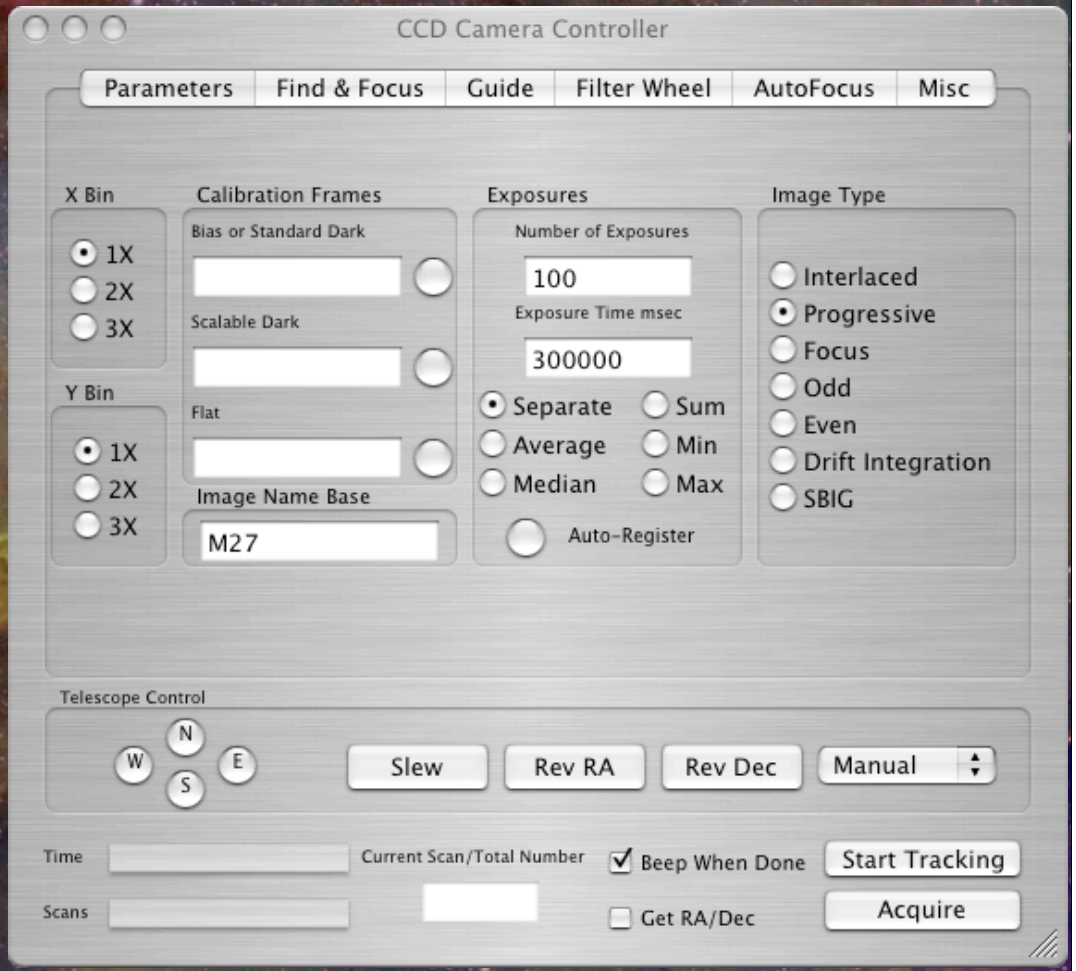

Why iCCD?
Minimalist Interface
Simplified Feature Set
Powerful Processing Routines
FITS Viewer
Camera Control
Pretty Cheap, Too

Starlight Express

- MX7C
- MX7
- SXV-MX7
- SXV-MX7C
- SXV-H9
- SXV-H9C
- SXV-M8C
- http://www.astrovid.com
- http://www.starlight-xpress.co.uk

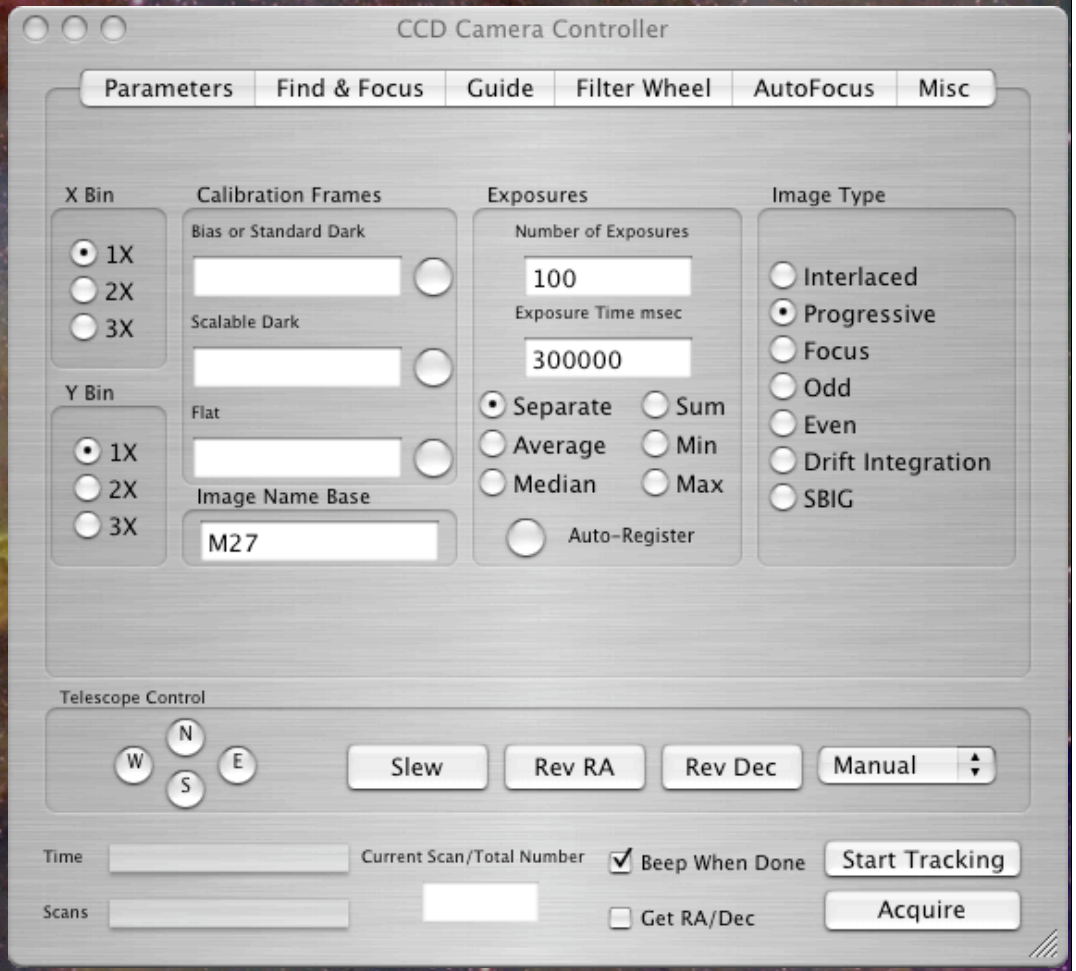
Collection

- CCD Camera Controller
- Camera:Open Control Window Menu Item



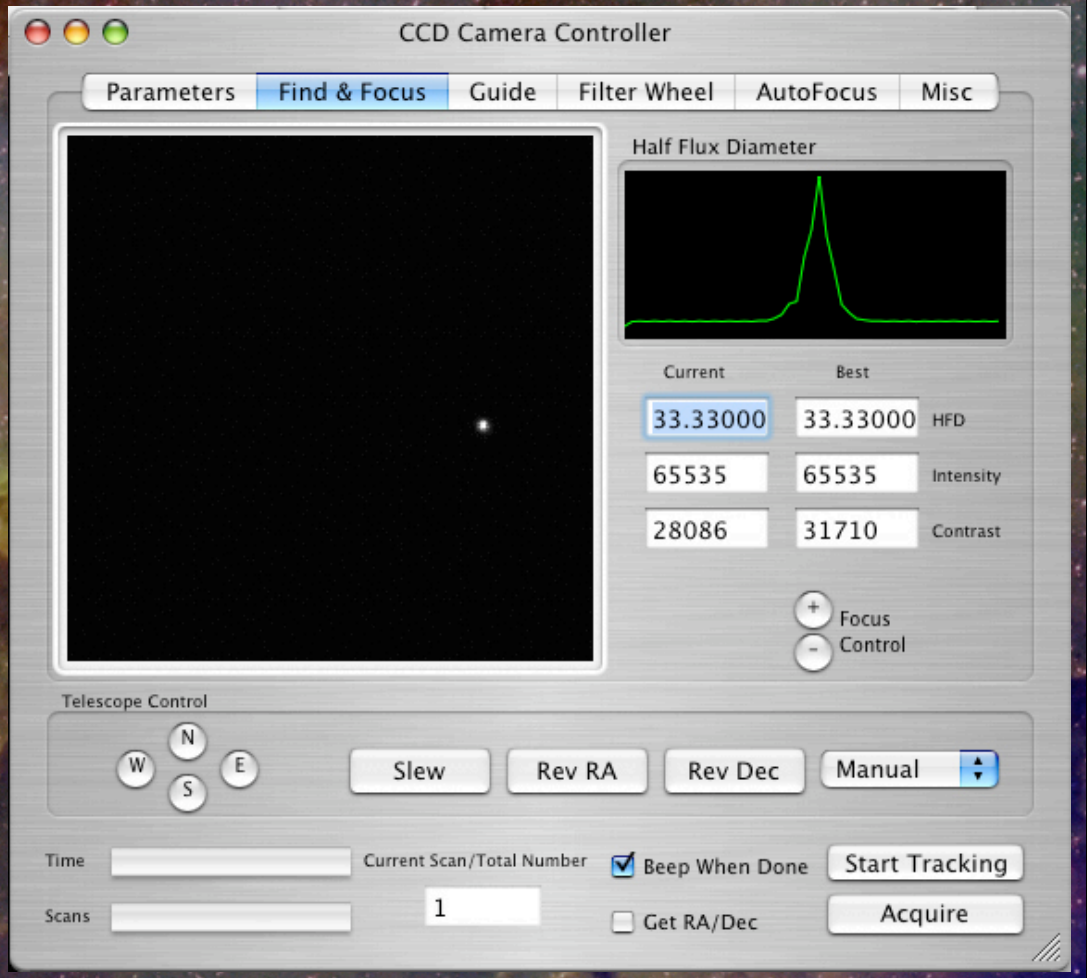
Collection

- Image Name
  - Autosave - M27_001.SX
- Number of Images
- Exposure Time
  - Milliseconds Best Exposure Control
  - 300000 msec = 5 minutes
- Binning
- Image Type
  - Progressive
  - Interlaced
  - Focus
- Acquire



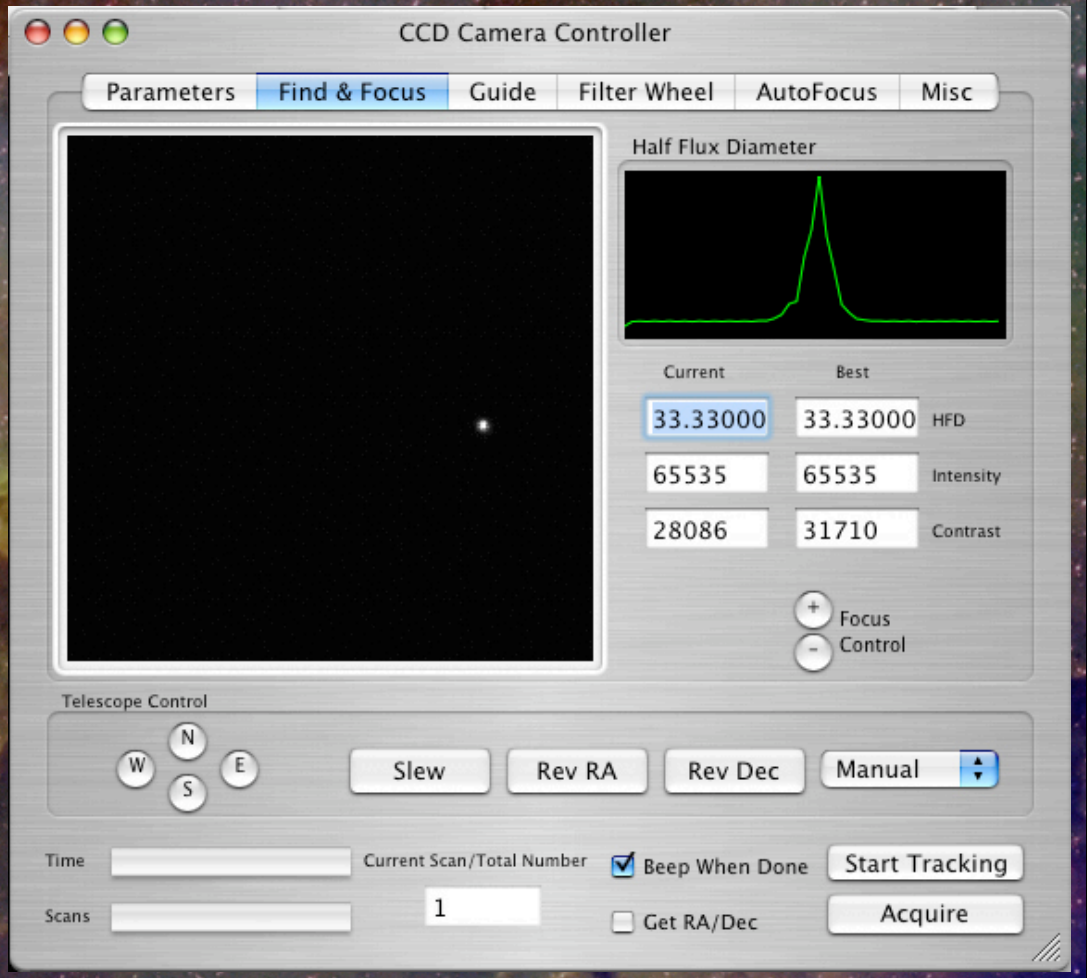
Focusing

- Collect an Image
  - Pick Bright Star
  - Not Saturated
  - Set Time < 5 sec
  - Click On Star to Select
- Select Focus Image Type
  - Parameters Screen
  - Acquire



Focusing

- Optimize
  - Pick Bright Star
  - Not Saturated
  - Set Time < 5 sec
  - Click On Star to Select
- Select Focus Image Type
  - Minimize HFD
  - Maximize Intensity
  - Maximize Contrast
    - Exception Minimize For
    - High Magnification Lunar/Planetary
    - Daytime Images
- Abort When Finished

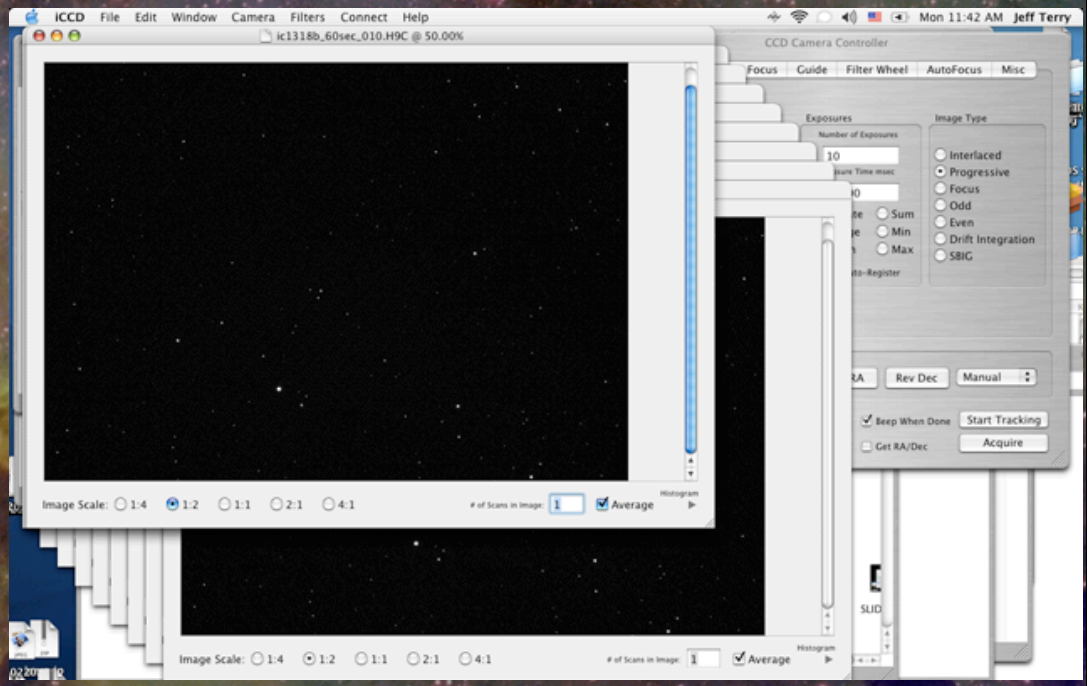


Focus Progression

- Focusing Is Crucial To Obtaining The Best Images
  - Image Resolution Is Lost When Imaging At An Incorrect Focus Position

Acquire

- After Focusing
- Select Image Type
  - Interlaced
  - Progressive
- Acquire
- Check Focus Every 15 - 30 Minutes Depending Upon Temperature



Color Imaging

- iCCD Automatically Color Converts Your Raw Images If You Are Using A Color Camera

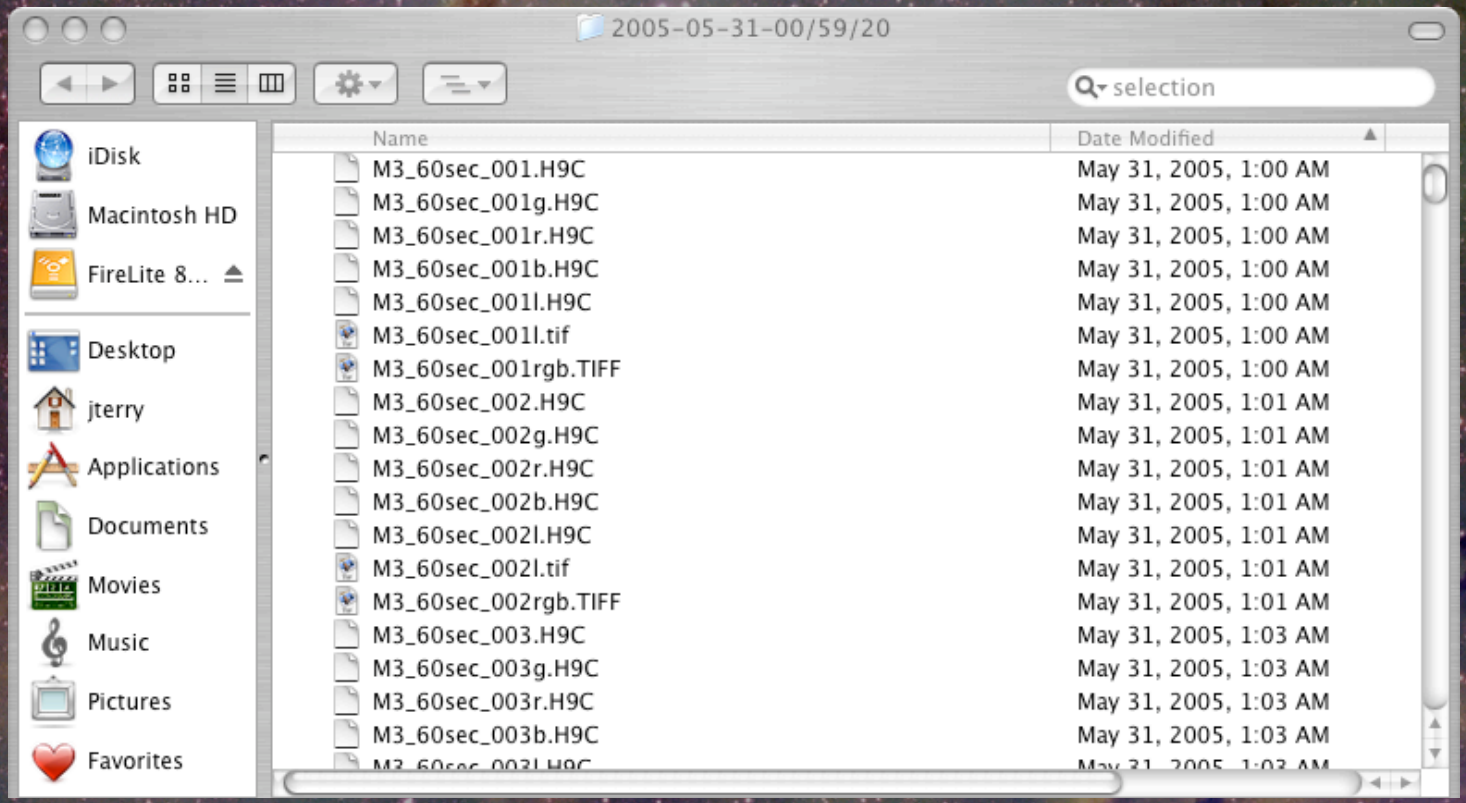


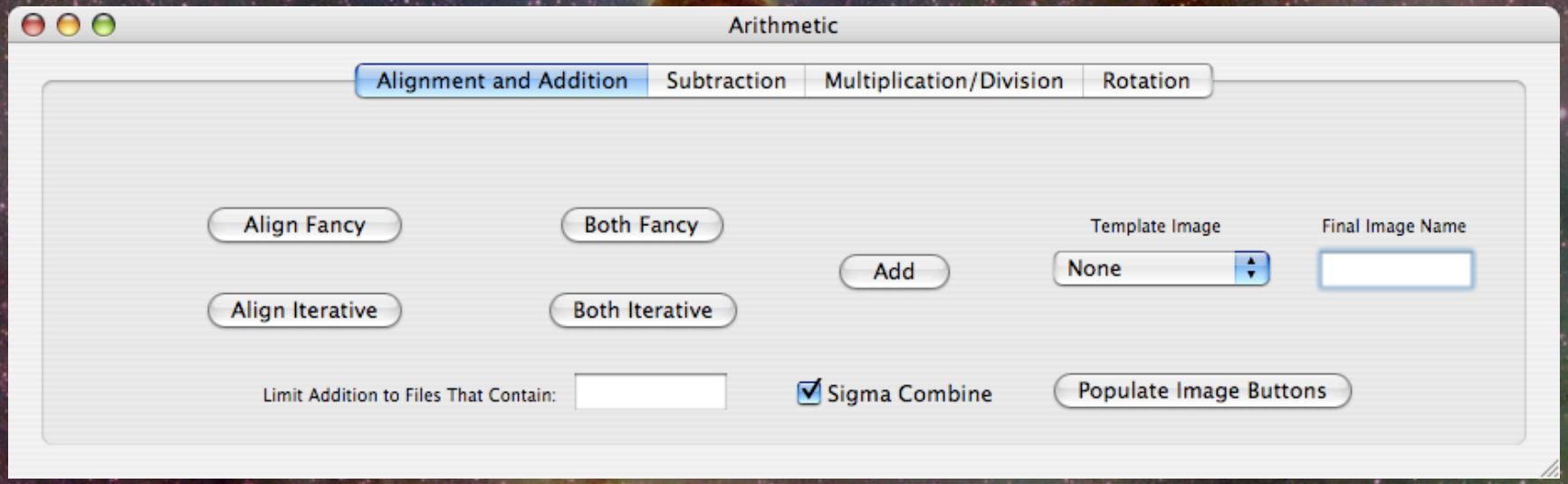
Image Calibration

- Bias Frames
  - Bias Frames Subtracted
- Dark Frames
  - Dark Frames Subtracted
- Light Frames
  - Light Frames Divided

Image Calibration

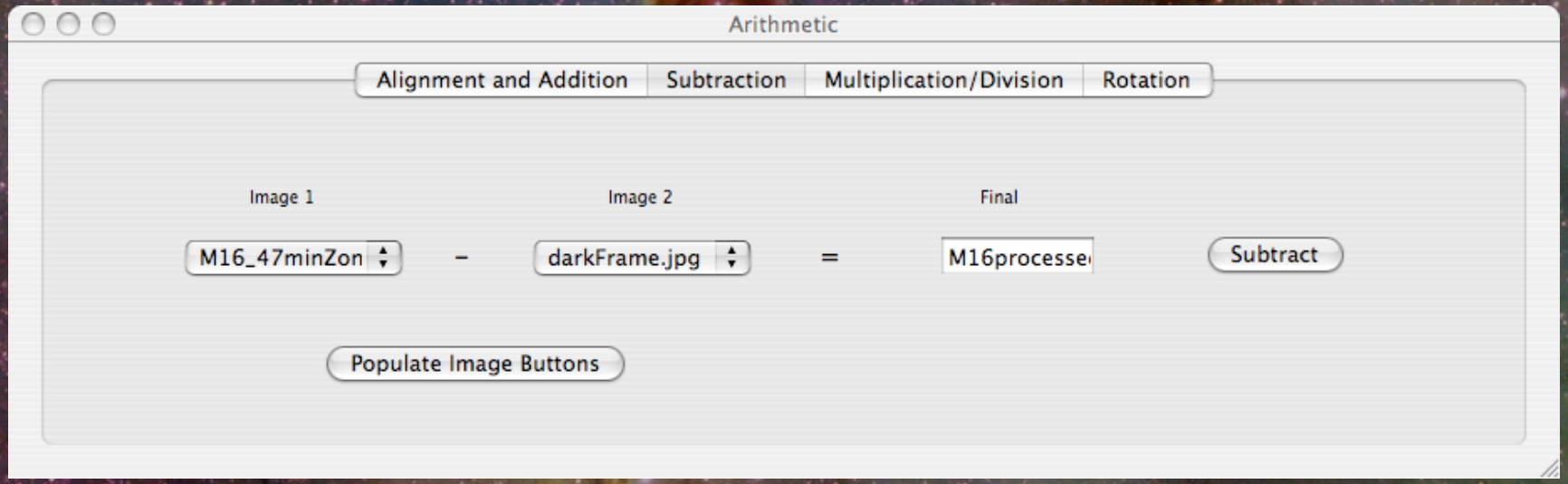
- iCCD Provides Arithmetic Routines For Handling Dark, Light, and Bias Frames
- Processing These Calibration Frames Always Adds Noise To An Image
- 90% Of The Time Bias and Dark Corrections are Unnecessary For The SX Cameras
- Light Frames Are Only Needed To Correct For Vignetting Or Dust Particles

Arithmetic



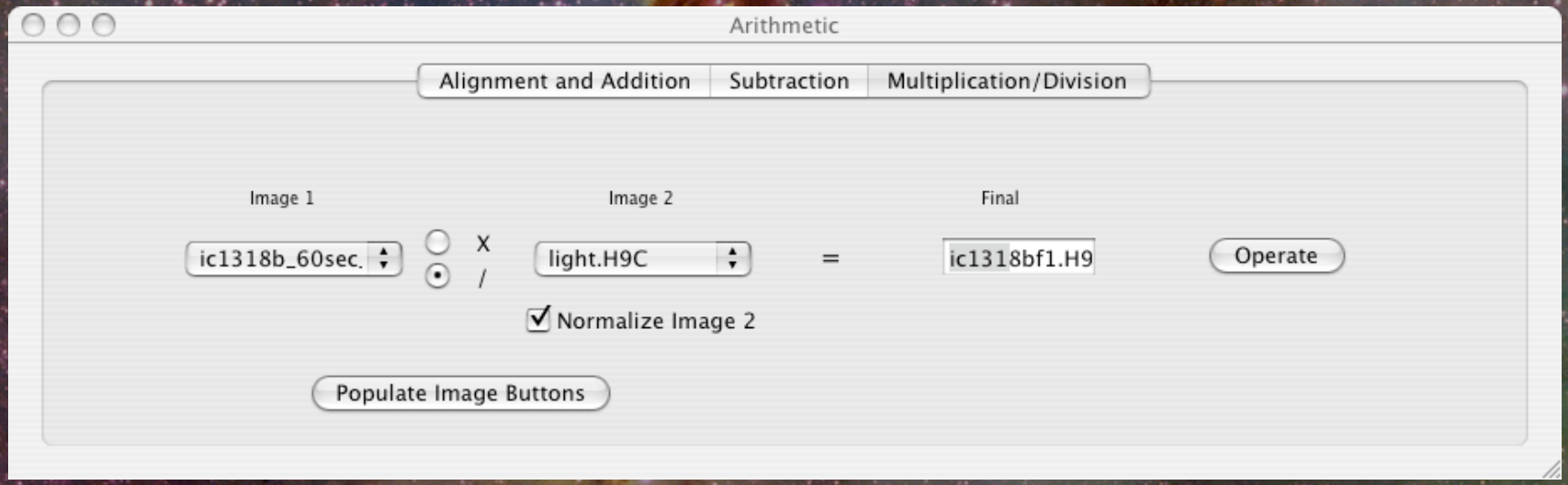
- Filters:Arithmetic Menu Item
- Four Tabs
  - Alignment and Addition
  - Subtraction
  - Multiplication/Division
  - Rotation

Subtraction



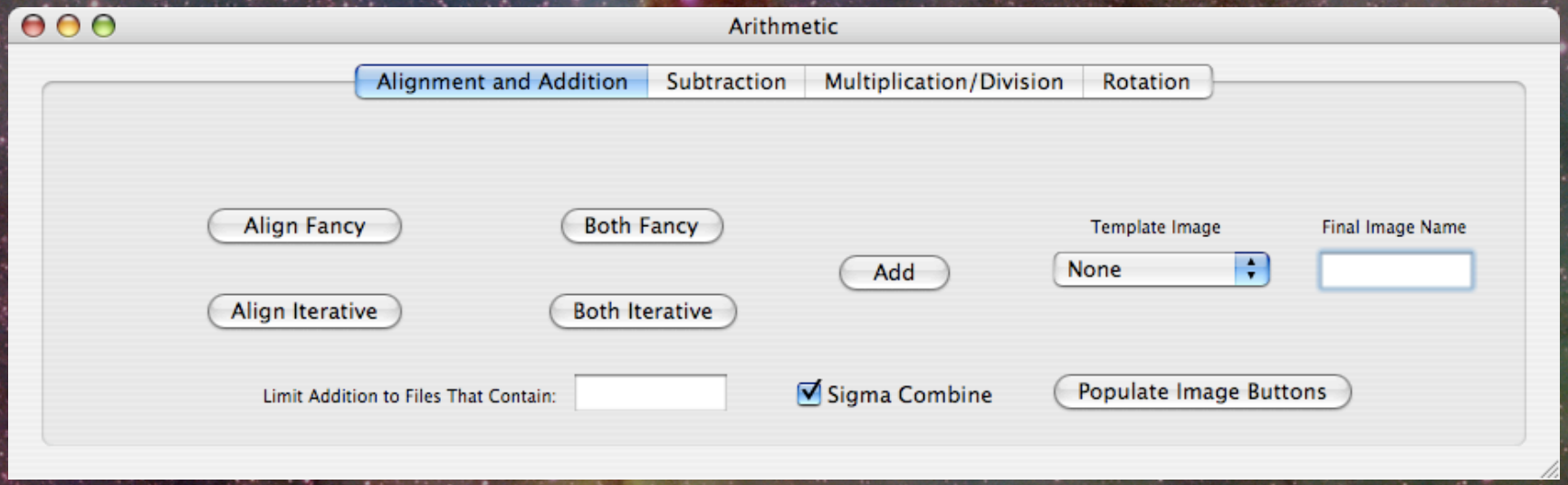
- Hit Populate Image Buttons
- Select Two Images To Subtract
- Bias Frames 1 msec
- Dark Frames Equal To Exposure Time

Multiplication / Division



- Hit Populate Image Buttons
- Select Two Images
- Select Operator and Normalization
- Light Frames Equal To ~ 30000 ADU

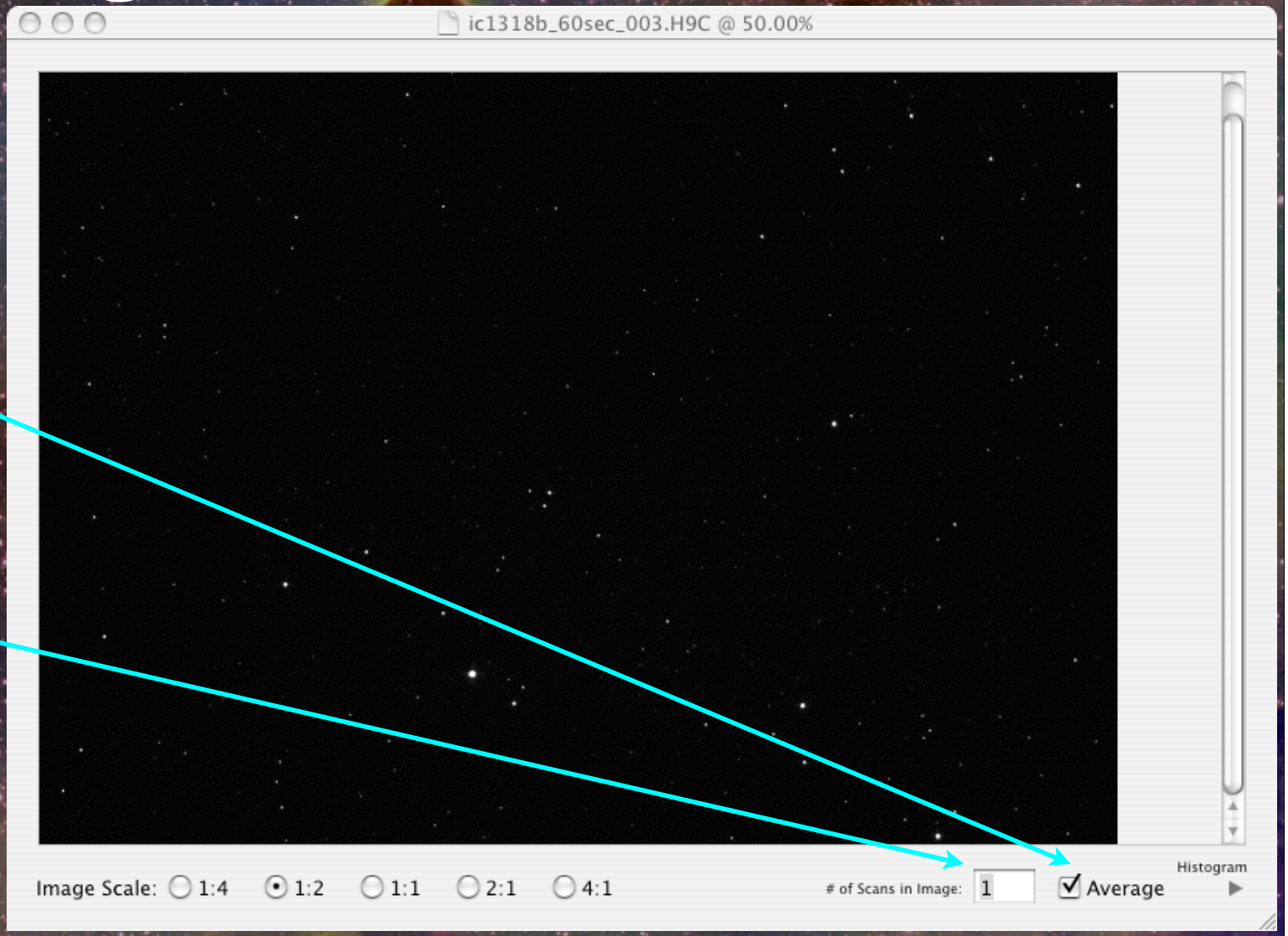
Alignment / Addition



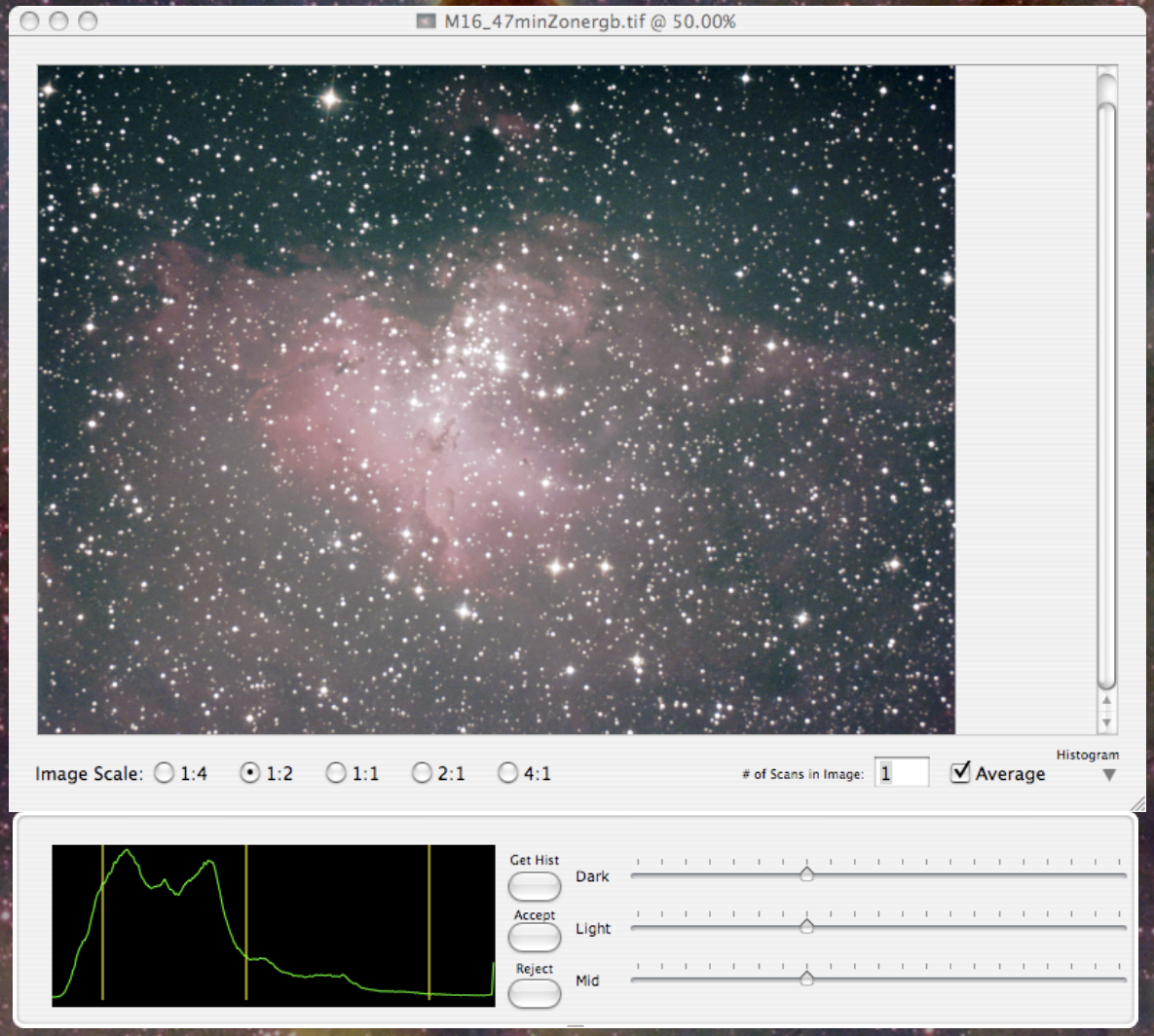
- Finally, happy with an image alignment procedure
- Addition
  - Average or Sigma Combine

Alignment / Addition

- Addition
- Include in Average Box
- Equivalent Scans in Image



Histogram

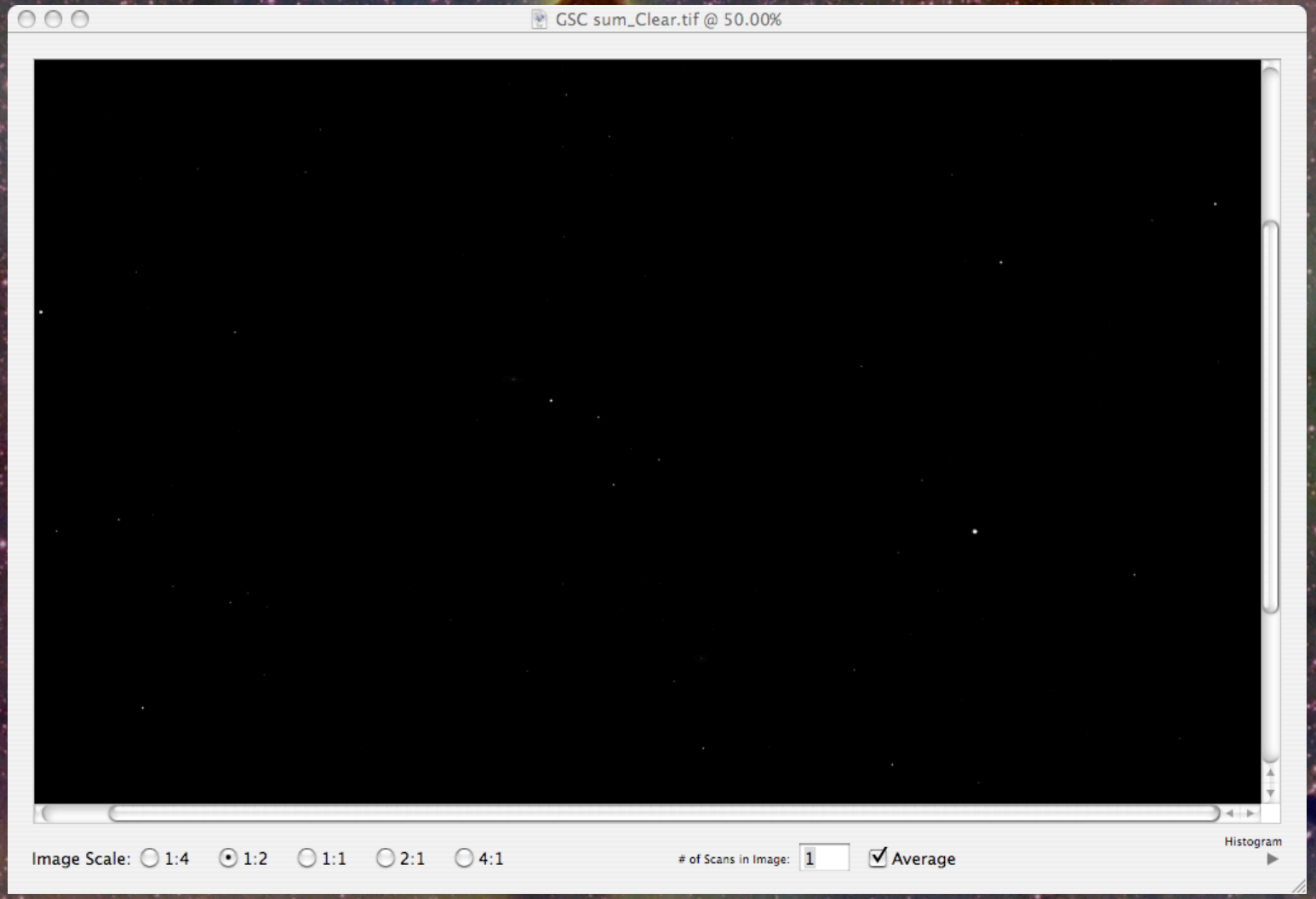


- Histogram Allows For Level Adjustment

Filters

- Digital Development
  - Filters:Digital Filters:Digital Development
  - Filters:Digital Filters:DDP No Sharpen
- Automatic Level Adjustment

DDP



- DDP Image Brings Out Regions of Lower Intensity

DDP

- DDP Image Brings Out Regions of Lower Intensity

Hot Pixel Killer

- The Hot Pixel Killer
  - Filters:Digital Filters:Hot Pixel Killer
- Removes Hot Pixels From A Single Frame
  - Recommended on Color Frames From Color Cameras

Deconvolution

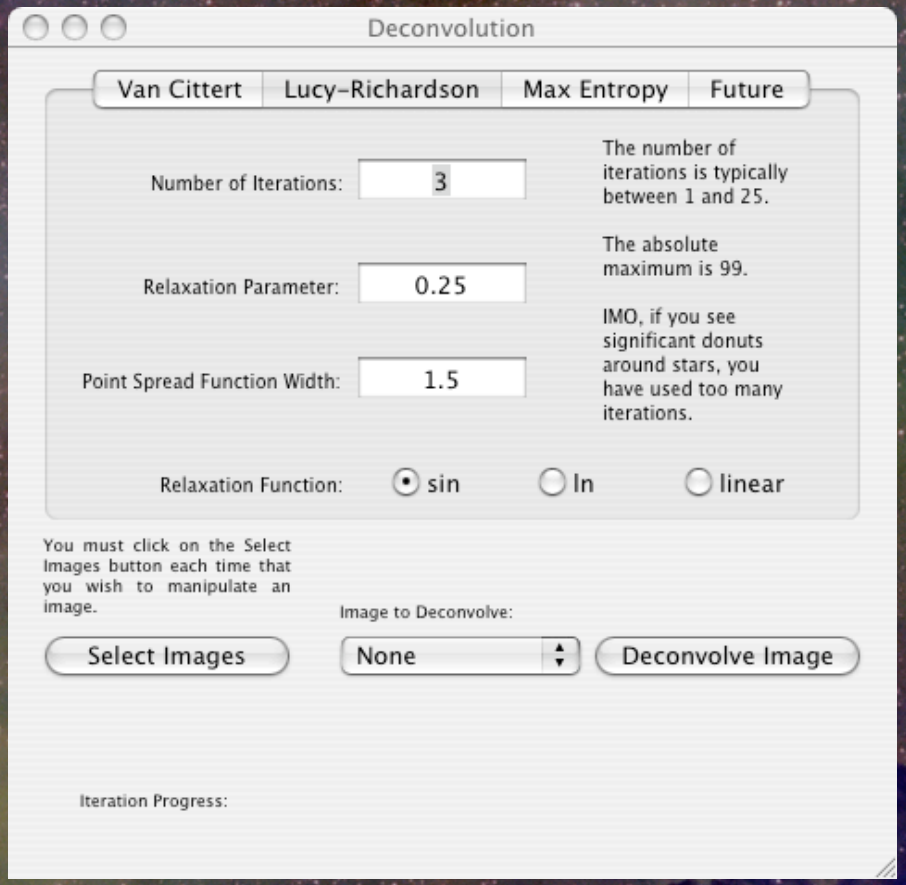
- Should Only Be Used On Luminance Frames
  - Do Not Deconvolve Color Frames
- Less Is More
  - Deconvolution Adds Significant Noise Per Iteration

Deconvolution

- Lucy-Richardson
  - Better on Deep Sky
- Van Cittert
  - Better on Lunar / Planetary
- Filters:Expert Filters:Deconvolution

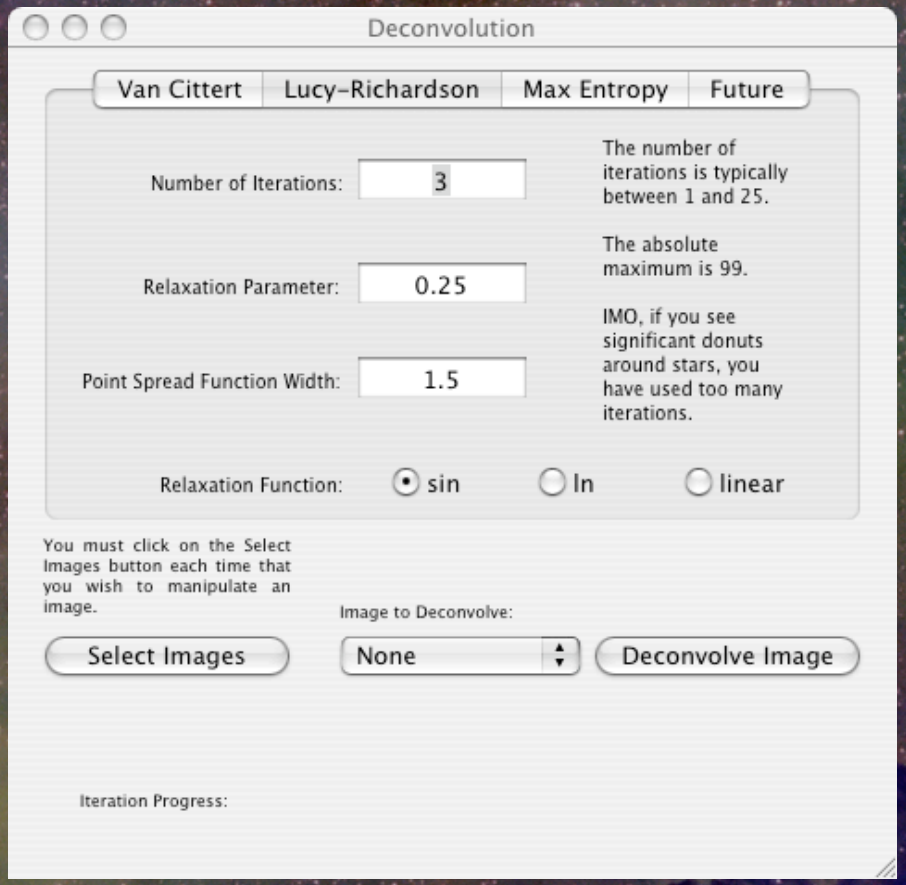
Deconvolution

- Number Of Iterations
- Relaxation Parameter
  - Controls How Fast Dim Regions Converge
- PSF Width
  - Width of Perfect System
- Relaxation Function
  - Controls What Is A Dim Region



Deconvolution

- Select Images Button Populates Images
- Pick The Image
- Deconvolve



Van Cittert

Lunar

Van Cittert

Lunar

Van Cittert

Lunar

Lucy - Richardson

- Dust Lanes Sharper, Better Defined

Lucy - Richardson

- Dust Lanes Sharper, Better Defined

Lucy - Richardson

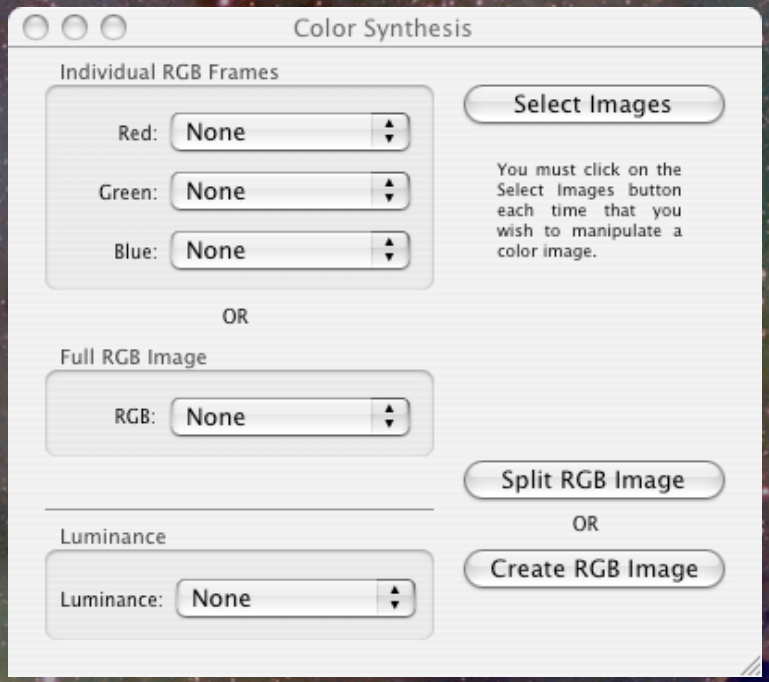
- Dust Lanes Sharper, Better Defined

Tri - Color Imaging

- Combine L, R, G, B Frames
- Split RGB Image To L, R, G, and B Frames
  - Create Synthetic Luminance Frame
- Filters:Color Synthesis:LRGB Operations

Tri - Color Imaging

- Select Images Button Populates The Frames
- Select RGB/L Frames or RGB Frame
- Create or Split Images
- To Create A Synthetic Luminance From RGB Frames
  - Create an RGB Then Split



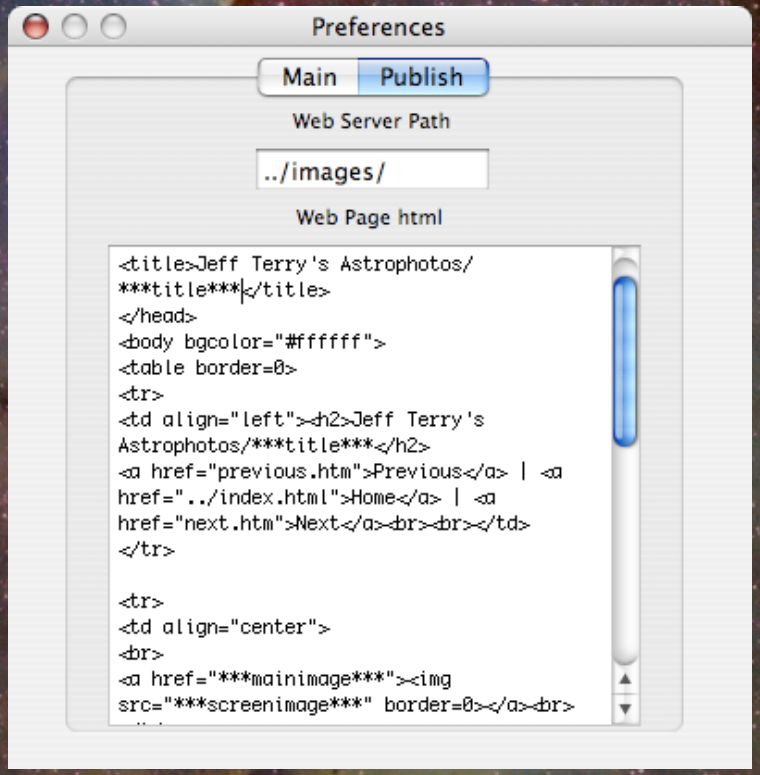
Blink

- The Blink Routine Helps Supernova and Asteroid Hunters
- Change Images While Blinking

Blink

- Supernova 2005cs

Help



- Make the computer do the work

Still To Come

- Autoguiding
  - SX Guider
  - Fishcamp Engineering Guider
- Advanced Deconvolution Routines
- Improved Alignment Routines - Done
- Easy of Use Improvements

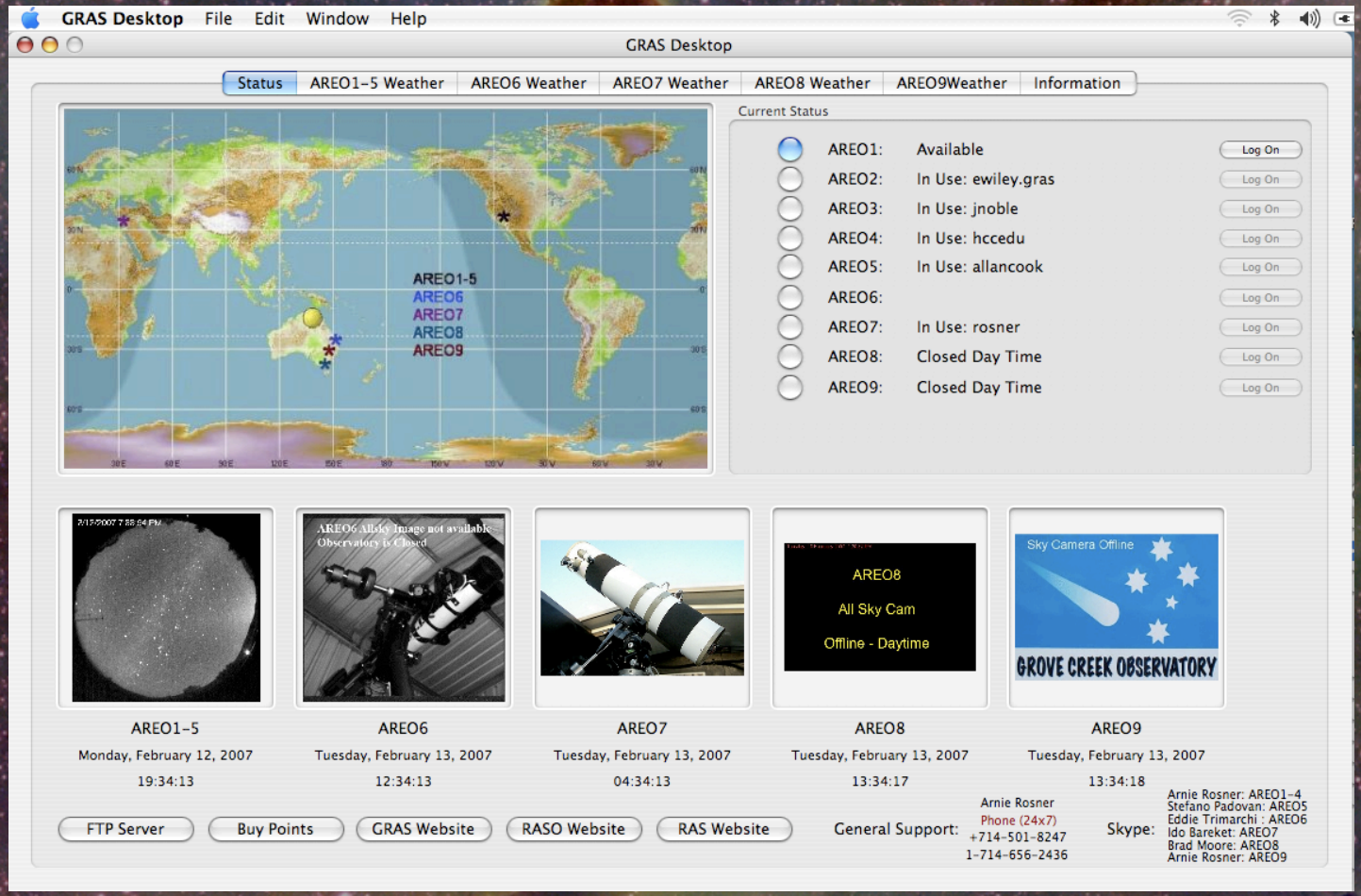
Summary

- Simple
- No Feature Bloat
- Most Features Used On Every Image
- Easy To Create Pretty Pictures
- Mac - Only

Contact

- http://www.iccd.us
- http://www.macastroimager.com
- http://www.macastroimaging.com
- terryj@iit.edu

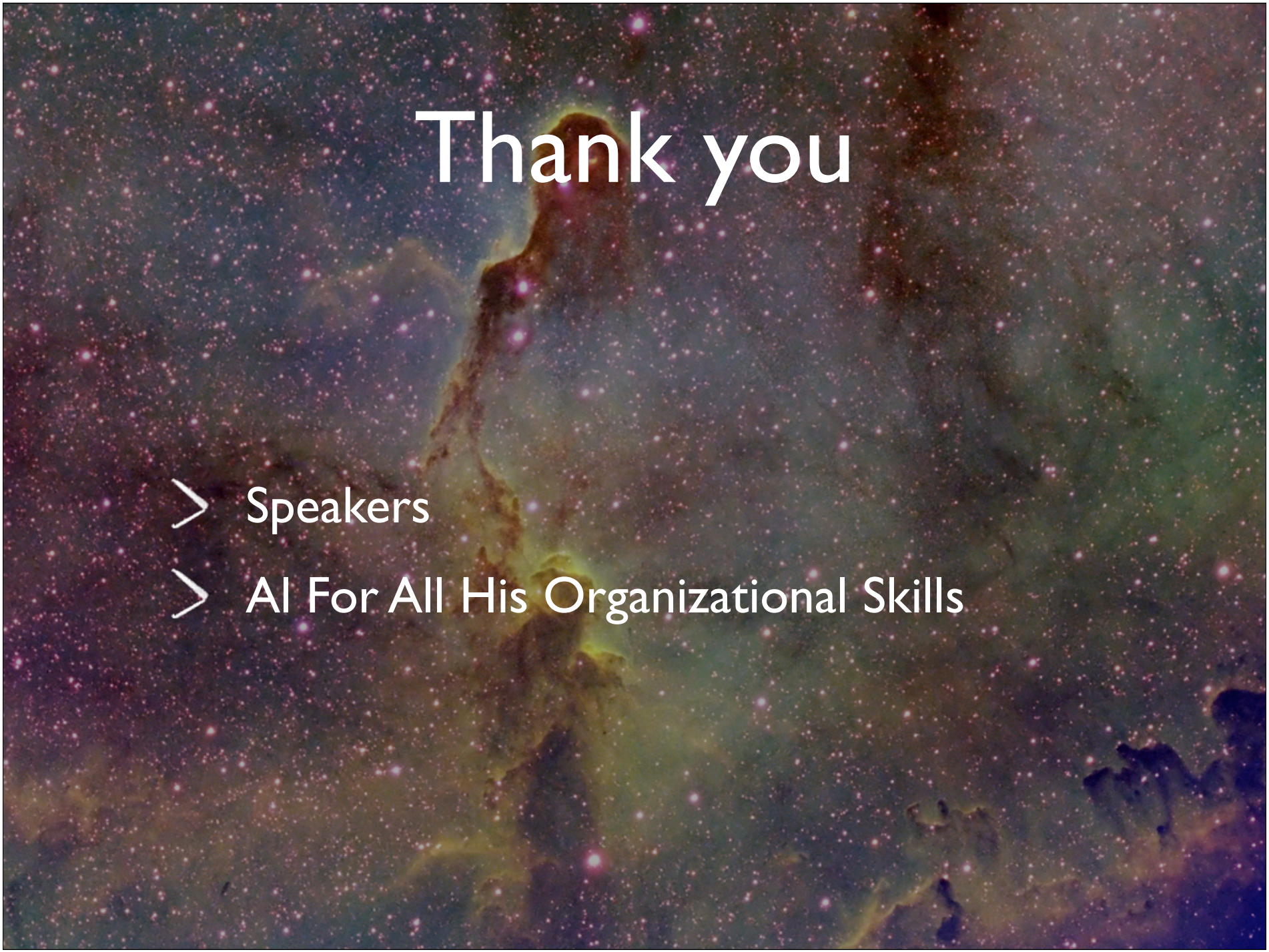
Remote Observing



- Global Rent A Scope
- http://www.macastroimager.com/GRAS_Desktop.html

For Your Consideration

- Evaluation
  - www.skyinsight.net/maic/eval.php
- Magazine
  - www.astrophotoinsight.com


Thank you
Speakers
AI For All His Organizational Skills